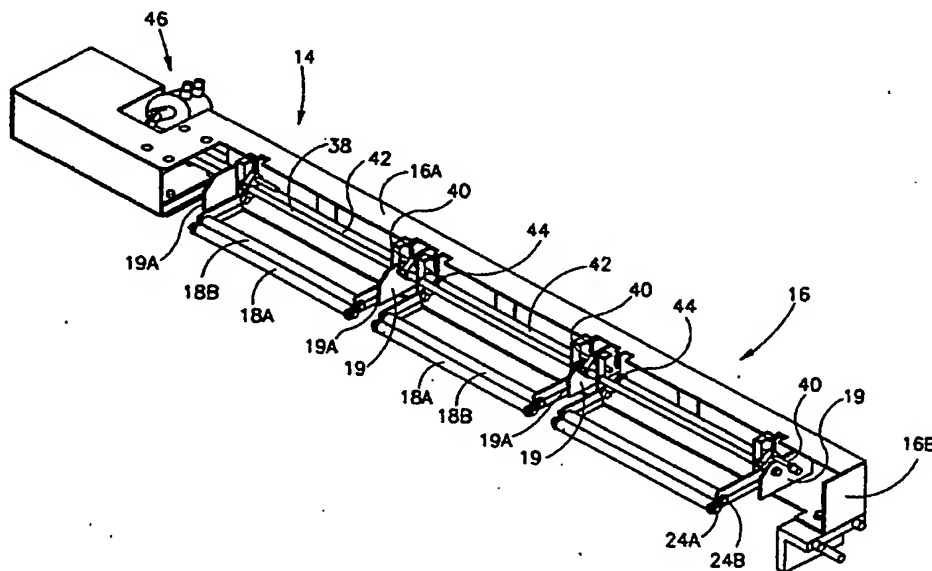




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(21) International Application Number: PCT/IL99/00370 (22) International Filing Date: 7 July 1999 (07.07.99) (30) Priority Data: 125471 23 July 1998 (23.07.98) IL (71) Applicant (for all designated States except US): ORBOTECH LTD. [IL/IL]; P.O.B. 215, 81102 Yavne (IL). (72) Inventors; and (75) Inventors/Applicants (for US only): DACHIM, Uri [IL/IL]; HaHadarim St. 7, 74022 Nes Ziona (IL). HADASI, Tal [IL/IL]; Rakefet, 20175 D.N. Misgav (IL). ALTMAN, Israel [IL/IL]; HaDror St. 1, 55600 Kiryat Ono (IL). TEICHMAN, Eyal [IL/IL]; Sokolov St. 53, 62284 Tel Aviv (IL). (74) Agent: REINHOLD COHN AND PARTNERS; P.O.B. 4060, 61040 Tel Aviv (IL).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>

(54) Title: CONVEYING METHOD AND DEVICE FOR LOADING/UNLOADING ARTICLES



(57) Abstract

Device and method are presented for conveying a substantially flat article from a first support surface onto a second support surface, wherein the first support surface transports the article in a conveying direction. The device comprises a support assembly and a drive means for driving a reciprocating movement of the support assembly in a predetermined direction. The support assembly is associated with the second support surface and is adapted for supporting a leading portion of the article. The support assembly supportingly engages the leading portion of the article ensuing from the first support surface, when the article reaches a first predetermined position, and disengages support of the leading portion of the article, when the article reaches a second predetermined position, relative to the second support surface.

Conveying Method and Device for Loading/Unloading Articles

FIELD OF THE INVENTION

This invention is in the field of conveying techniques and relates to a device for loading/unloading articles to and from a working station.

BACKGROUND OF THE INVENTION

Continuous mass production of various workpieces requires the development of conveying systems capable of transporting a stream of workpieces from a supply stack to a return stack through one or more working stations for processing operations, for example cutting, recording, inspecting, or the like. The supply and return stacks are typically located on self-leveling tables, each including an automatic lifting mechanism for continuously lifting the stack from the bottom to maintain the topmost article at a predetermined vertical position.

- (b) a drive means for driving a reciprocating movement of the support assembly in a predetermined direction, so as to supportingly engage the leading portion of the article, when the article reaches a first predetermined position, and disengage support of said leading portion of the article, when the article reaches a second predetermined position, relative to said second support surface.

The main idea of the present invention is based on the following. The article moves in the conveying direction being progressively supported by the first support surface. The support assembly is associated with the second support surface, being either coupled or accommodated proximate thereto, and is driven for sliding movement along an axis parallel to the conveying direction between the two opposite sides of the second support surface.

The support assembly comprises a support frame having a portion which extends substantially transversely to the conveying direction.

According to one embodiment of the invention, the support assembly comprises a gripper device mounted on the above portion of the frame. The gripper device is formed by at least one pair of elongated clamping jaws driven for pivotal movement between their closed position for supportingly engaging the article within its leading portion and an opened position for disengaging support of the article. The support frame may be in the guiding means, for example a pair of guidance rails, for guiding the reciprocating movement of the support assembly. Preferably, the jaws are pivotal in a shears-like manner by a pair of symmetrically identical linkage assemblies, provided at opposite ends of the jaws. Each of the linkage assemblies comprises a pair of pivotally coupled connecting rods rotatably mounted on a shaft such that the revolution of the shaft causes the pivotal movement of the connecting rods. The jaws are pivotal between their closed and opened

- (iii) disengaging support of the article, upon detecting that the article reaches a second predetermined position, relative to the second support surface.

BRIEF DESCRIPTION OF THE DRAWINGS:

In order to understand the invention and to see how it may be carried out in practice, a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Figs. 1a and 1b are schematic perspective and top views of a production line utilizing a conveying device constructed according to one embodiment of the invention;

Fig. 2 more specifically illustrates one example of a support assembly suitable for the conveying device of Figs. 1a and 1b;

Figs. 3a and 3b illustrate the support assembly of Fig. 2 in two different positions of clamping jaws;

Figs. 4a and 4b more specifically illustrate a linkage means suitable for the pivotal movement of the clamping jaws between their different positions shown in Figs. 3a and 3b;

Figs. 5a to 5c illustrate the main principles of operation of a piston device suitable for driving the movement of the clamping jaws;

Figs. 6a to 6f are schematic illustration of the conveying device shown in Figs. 1a and 1b, in its sequential operational stages;

Fig. 7 is a schematic illustration of a conveying device constructed according to another embodiment of the present invention; and

Fig. 8 is a schematic illustration of a support assembly designed according to another example of the present invention, suitable for the conveying devices of Figs. 1a-1b and of Fig. 7.

are collected. Each PCB, when being inspected, is progressively supported partly on the conveyor belts **B** and partly on the rotatable drum **9**.

The construction and operation of the working station **2** do not form a part of the present invention and therefore need not be specifically described, except to note that the working station **2** typically comprises optical, sensing and processing means for scanning the article to locate defects. The supply conveyor **4** may also be of any suitable construction, for example, such as that disclosed in co-pending European Patent Application No. 97300521.8 assigned to the assignee of the present application.

The unloader **8** is accommodated close to the conveyor **4** downstream thereof. The unloader **8** comprises a self-leveling collecting table **10** for maintaining the vertical position of its upper surface **10a**. The construction and operation of the table **10** are known *per se*. It is understood that, in this specific "loaded" state of the table **10**, its upper surface **10a** is that defined by an upper surface of the topmost collected article.

The essential feature of the present invention is the provision of a conveying device, generally designated **12**, for discharging the inspected PCBs from the supply conveyor **4** (constituting a first support surface) onto the support surface **10a** (constituting a second support surface). According to the present example, the conveying device **12** is associated with the support surface of the unloader **8**.

The conveying device **12** comprises a support assembly, generally designated **14** mounted on an upper portion **16a** of a support frame **16**. As shown, the portion **16a** is positioned slightly above the surface **10a**, extending transverse to the conveying direction **D**. According to the present example, the support assembly **14** represents a gripper device formed by three pairs of elongated, normally-closed, clamping jaws **18a-18b**. It should be noted that, generally, the provision of at least one pair of such clamping jaws is sufficient, but, preferably, several pairs of jaws are used so as to be

pairs 18a-18b. The plates 19 are formed with substantially flat front surfaces 19a to engage an outer surface of the front edge of the article (not shown). The provision of the plates 19 is optional and is aimed solely at preventing the undesirable progression of the article A. The surfaces 19a serve as the article movement position stops, ensuring that the article is captured at its "margin" non-patterned region.

The lower and upper jaws 18a and 18b are mounted on pins 24a and 24b, respectively. In the present example, the jaws are designed like rubber rollers, at least one of them, and preferably the upper roller 18b, being rotatably mounted on the pin 24b, the purpose of which will be described further below. The pins 24a and 24b are driven for pivotal movement against and towards each other between their closed (Fig. 3a) and open (Fig. 3b) positions in a shear-like manner. This is implemented in the following manner.

Two symmetrically identical linkage assemblies, generally designated 26, support the opposite ends of the pins 24a and 24b. The linkage assembly 26 comprises a pair of connecting rods 28 and 30 pivotally coupled to each other via an axis 32. The angular-shaped connecting rod 28 at its one end supports the end of the lower pin 24a, while the connecting rod 30 at its one end supports the end of the upper pin 24b. Free ends of the connecting rods 28 and 30 are attached to the portion 16a via a pair of springs 34 and 36, respectively.

The connecting rods 28 are pivotally mounted on a common shaft 38 extending along the portion 16a. The shaft 38 is rotatably supported by the plates 19 and is at its opposite ends rotatably mounted on the carrier 16a. The relationship between the location of the axis 32 and that of the shaft 38, as well as their relative locations relative to the vertex portion of the angular-shaped connecting rod 28, are shown in the drawings in a self-explanatory manner.

opening of the jaw 18a is yet further increased by restricting the pivotal movement of the jaw 18b. These features are essential especially for releasing the article from the clamping jaws.

Figs. 5a to 5c illustrate a piston device 46 that operates the revolution of the shaft 38. The piston device 46 may be of any known kind, for example Air Cylinder Double Acting G-7-X-PM-RC-19 commercially available from Fabco Air Co. USA. The piston device 46 is pivotally mounted on the frame 16 through a connecting rod 47. A reciprocating member 48 of the piston device 46 is coupled to the shaft 38 through a connecting rod 50 (or plurality of appropriately interconnected rods) having a substantially L-shaped portion 50a. The connecting rod 50 is affixed to the shaft 38 and pivotally connected to the reciprocating member 48. It is understood that the pivotal connection of the piston device 46 relative to the frame 16 provides a degree of freedom for the motion of the device 46 within the plane of motion of the connecting rod 50. The advance of the member 48 into its projected position causes the revolution of the shaft 38. It is clear, although not specifically shown here that this results in the pivotal movement of the jaws 18a and 18b into their open position against the tension of the springs 34 and 36. When the member 48 is returned back into its retracted position, the springs 34 and 36 immediately assist the jaws 18a and 18b to move towards each other for clamping the PCB A with a pressure defined by the tension of the springs 34 and 36.

A suitable sensing means 53, such as Photo Interrupter TLP1201-C1 commercially available from Toshiba, are provided for controlling the position of the portion 50a. The position of the portion 50a is indicative of the position of the clamping jaws 18a-18b. The sensing means 53 are coupled to a control unit, which is not specifically shown, for synchronizing the operation of the conveying device 12. The control unit does not form a part of the present invention and may be of any known kind.

guidance rails 20 away from the conveyor 4, i.e. towards the "right" position of the jaws' carrier 16a in the drawings. As clearly shown in Fig. 6d, the opposite edges of the PCB A are supported by the clamping jaws 18a-18b and by guiding rollers 5b-7b, respectively. The guiding rollers 5b-7b provide desired high tension of the progressing PCB, provided the speed of the sliding movement of the frame 16 is brought into conformity with that of the rotation of the conveyor belts. It is important to note that the provision of the guiding rollers 5b-7b assists the progression of a flexible article and prevents it, as well as an underneath article (topmost one in the collected stack) from being damaged.

When the entire PCB A is positioned above the surface 10a, the sliding movement of the frame is halted and jaws 18a and 18b are again pivoted into their open position (not shown) for releasing the PCB A. Preferably, an additional sliding movement of the frame is provided during the opening of the jaws, so as to avoid a possible sticking of the PCB. Thereafter, the jaws are pivoted in to their closed position (Fig. 6e) and the frame 16 slides into its initial position. As shown in Fig. 6f, the gripper 14 is again in its ready-to-grip state for conveying a next PCB A' from a moving support surface defined by the conveyor 4 onto a further stationary support surface defined by the collecting table 10.

It should be noted that, according to the above-described example, the support frame 16 is mounted on the collecting table 10. In other words, the entire conveying device 12 is the constructional part of the unloader 8.

Alternatively, the conveying device may be a stand-alone unit accommodated so as to enclose a support surface between the sidewalls of the frame. Such a conveying device is schematically illustrated in Fig. 7, being generally designated 112. The same reference numbers are used for identifying those components, which are identical in the devices 12 and 112, in order to facilitate understanding. The conveying device 112 comprises a

218b are mounted in a pair of elongated recesses **220** made in the pair of sidewalls **216b**, respectively, and are driven by a suitable drive means (not shown) for reciprocating movement along the axes of the recesses. Optionally, arresting members **219** are provided having substantially flat front surfaces **219a** to engage the outer surface of the leading portion of the progressing article.

It is understood that, the leading portion of the progressing article becomes supported on the support members **218a** and **218b**, whilst ensuing from the guiding rollers **5b-7b**. In order to release the article and position it on the support surface **10a**, the support members **218a** and **218b** are actuated for sliding movement in the conveying direction within the recesses **220**. Alternatively, although not specifically shown, each of the support members **218a** and **218b** may be mounted for suitable pivotal movement about the respective sidewall **216**.

It should be specifically noted, that the provision of any movement of the support members relative to the sidewalls of the support frame is optional. Indeed, as described above with respect to the conveying device **12**, the release of the article may be implemented by sequentially halting and reestablishing the sliding movement of the entire support assembly **214** in the conveying direction **D**, upon detecting that the article is not longer progressively supported by the first support surface and is completely positioned above the second support surface.

It should also be noted that the support members **218a** and **218b** may be replaced by a single support member mounted on the sidewalls **216b** by its opposite ends. Alternatively, one or more plate-like support members may be mounted on the upper portion **216a** of the frame **216** so as to be oriented substantially parallel to the support surface **10a**.

Those skilled in the art will readily appreciate that various changes and modifications may be applied to the embodiments of the invention as

CLAIMS:

1. A device for conveying a substantially flat article from a first support surface onto a second support surface, wherein the first support surface transports the article in a conveying direction, the device comprising:

- (a) a support assembly associated with the second support surface and adapted for supporting a leading portion of the article;
- (b) a drive means for driving a reciprocating movement of the support assembly in a predetermined direction, so as to supportingly engage the leading portion of the article, when the article reaches a first predetermined position, and disengage support of said leading portion of the article, when the article reaches a second predetermined position, relative to said second support surface.

2. The device according to Claim 1, wherein the support assembly comprises a support frame having a portion extending substantially transversely to the conveying direction above the second support surface.

3. The device according to Claim 2, wherein said portion of the support frame is formed with at least one support member for supportingly engaging a lower surface of said leading portion of the article.

4. The device according to Claim 3, wherein said at least one support member is driven for movement relative to the support frame.

5. The device according to Claim 2, and also comprising a gripping device mounted on said portion of the support frame.

6. The device according to Claim 5, wherein said gripping device comprises at least one pair of elongated clamping jaws adapted for pivotal movement between their closed position for supportingly engaging the article within its leading portion and opened position for disengaging the

16. The device according to Claim 1, and also comprising a guiding assembly for supporting at least a portion of the article and guiding its sliding movement from the first support surface towards the second support surface.

17. The device according to Claim 16, wherein said guiding assembly comprises at least one pair of parallel rollers spaced-apart from each other a distance substantially equal to a thickness of said article.

18. The device according to Claim 16, wherein said first support surface is defined by a conveyor having at least one closed-loop belt supported by at least a pair of front and rear rollers, said guiding assembly being formed by said at least one rear roller of the conveyor and a corresponding one additional roller accommodated parallel to said rear roller and spaced-apart therefrom a distance substantially equal to a thickness of said article.

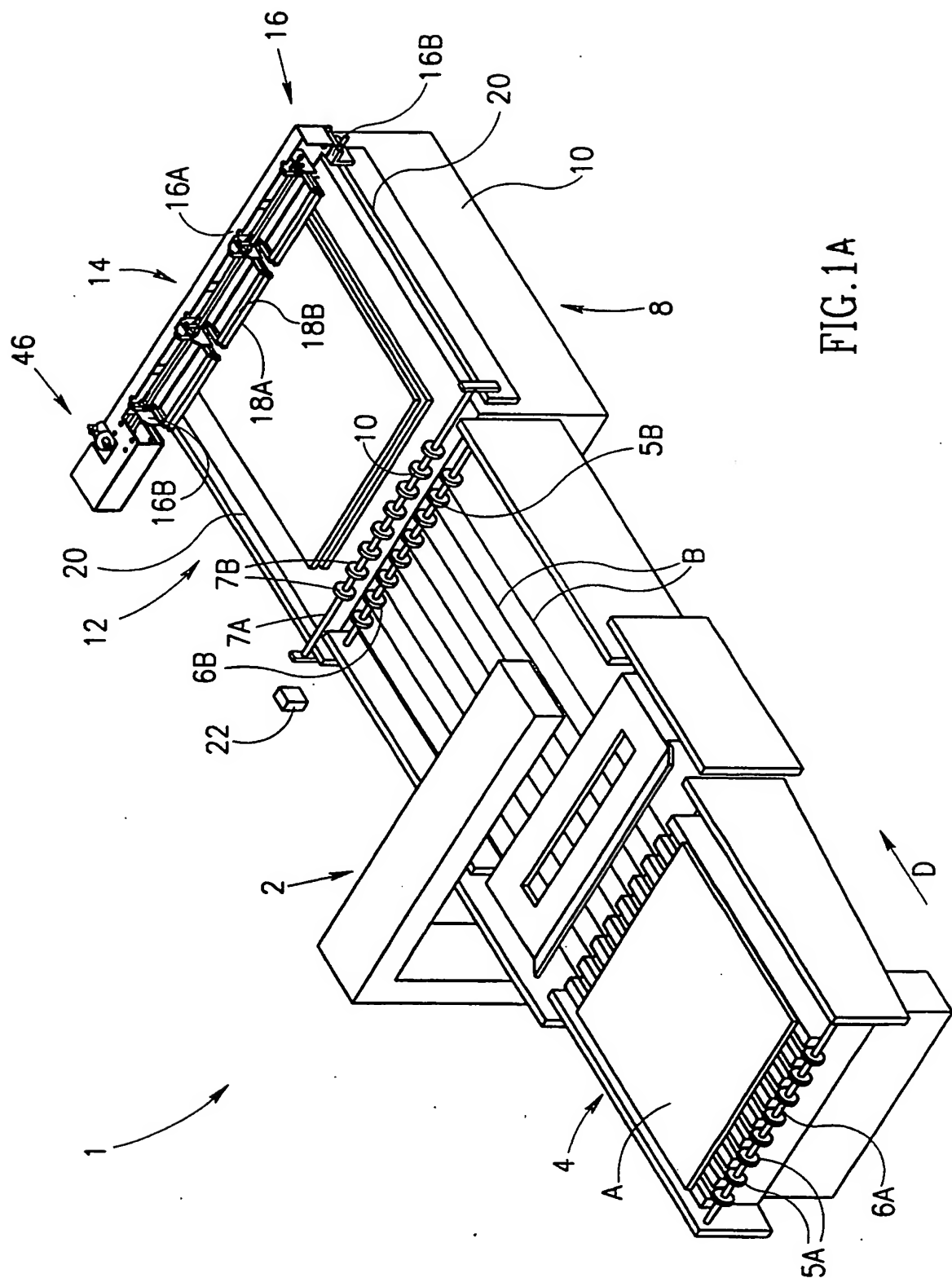
19. The conveying device according to Claim 1, and also comprising a control unit associated with said drive means for operating said reciprocating movement of the support assembly.

20. The conveying device according to Claim 6, and also comprising a control unit associated with said drive means and said actuator for operating said reciprocating and pivotal movements of the support assembly.

21. The device according to Claim 19, wherein said control unit comprises a sensor means for detecting said first and second predetermined position of the article.

22. The device according to Claim 1, wherein said drive means is a belt drive.

23. The device according to Claim 6, wherein said actuator comprises a piston device.



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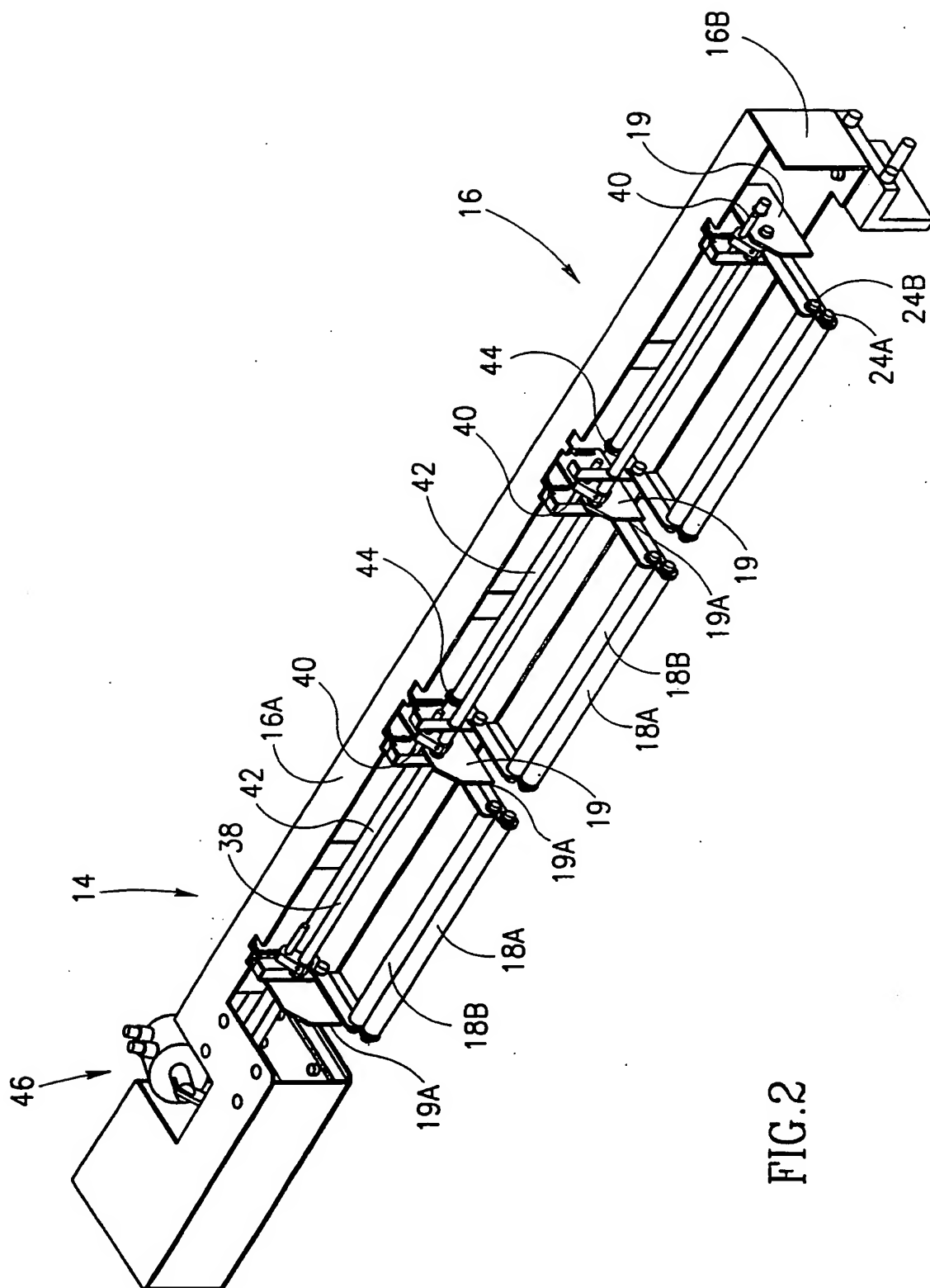


FIG. 2

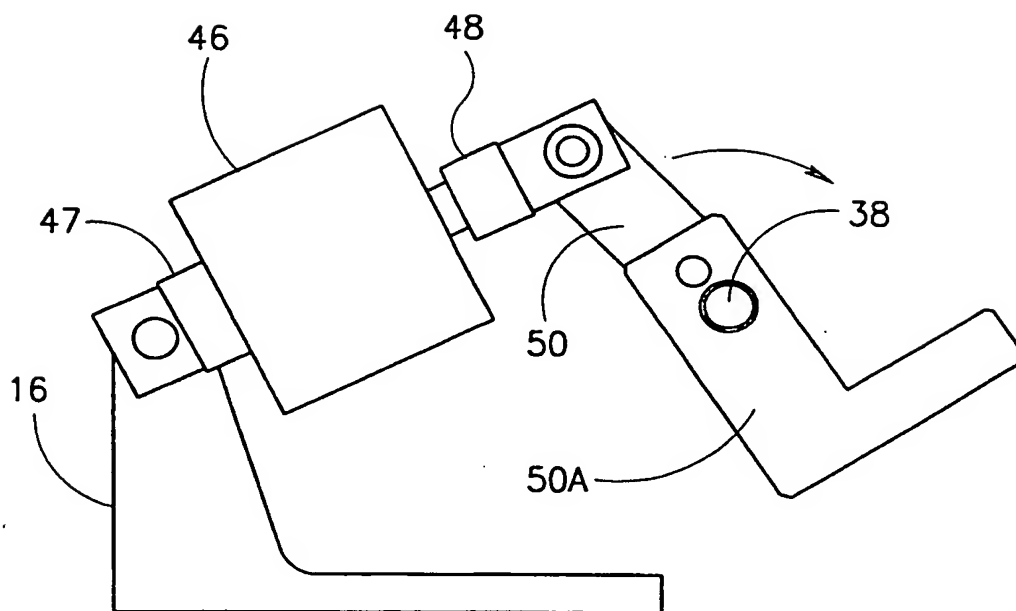


FIG.5B

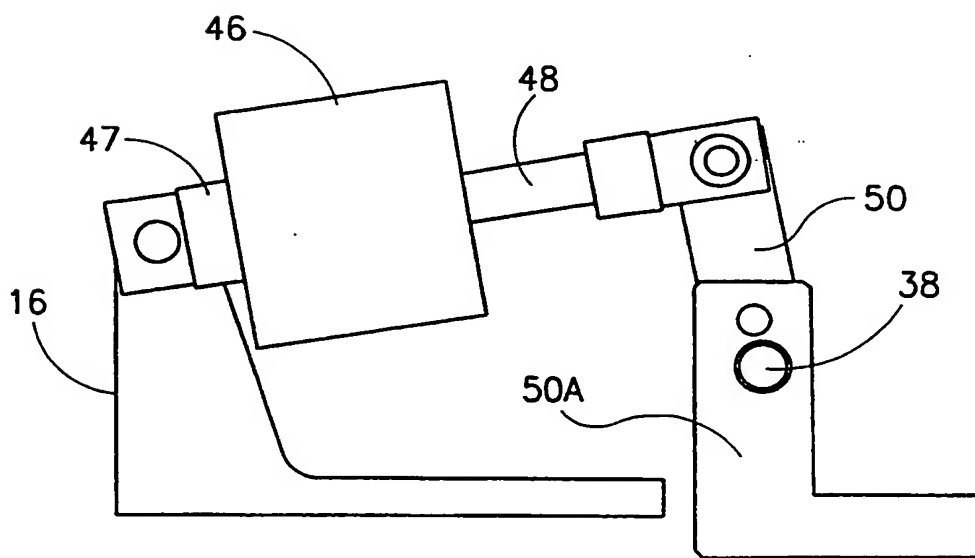


FIG.5C

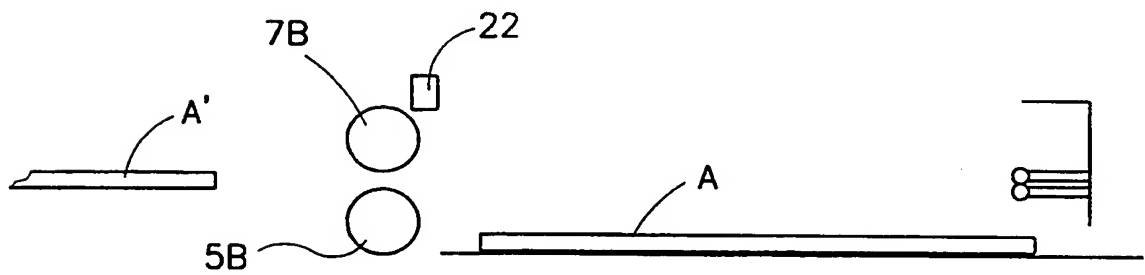
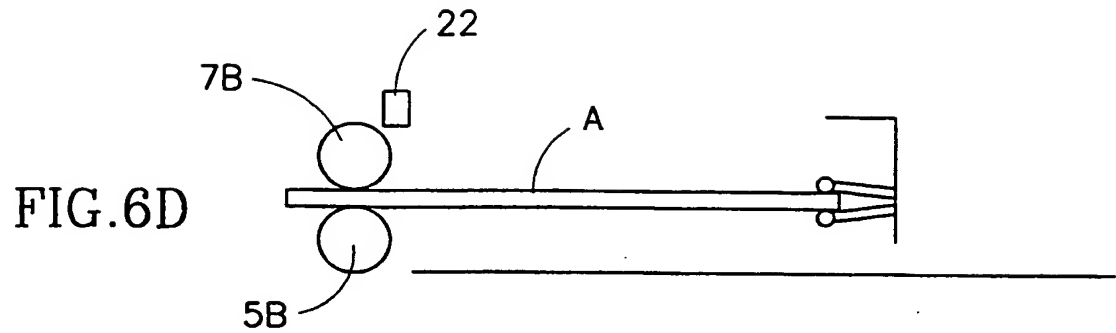


FIG.6E



FIG.6F

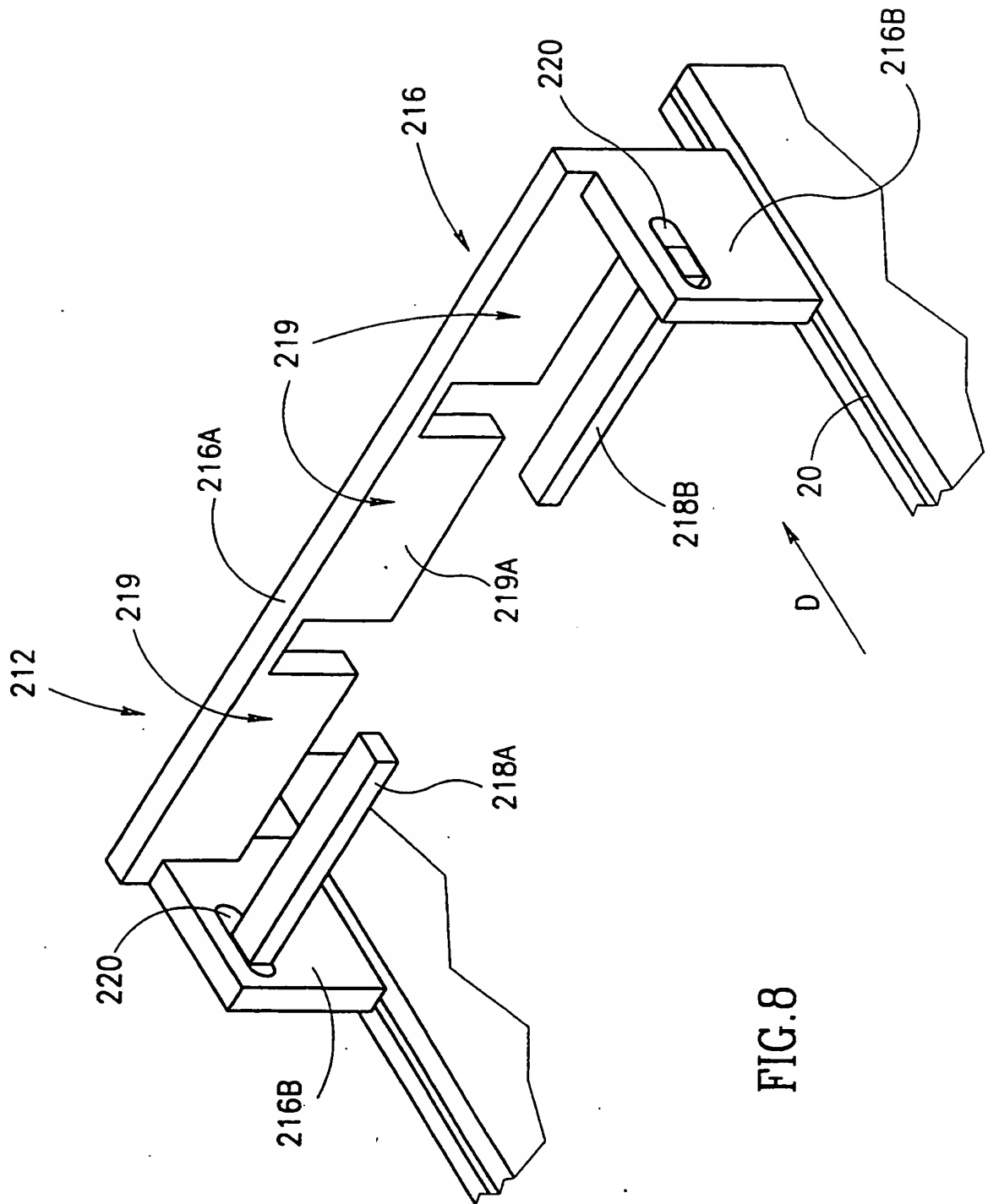


FIG. 8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IL 99/00370

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3690649 A	12-09-1972	NONE	
US 4903818 A	27-02-1990	DE 3717628 A EP 0292807 A JP 63300015 A	15-12-1988 30-11-1988 07-12-1988
US 4867297 A	19-09-1989	JP 2088806 C JP 7115274 B JP 63295148 A JP 1650551 C JP 3014579 B JP 63047037 A CH 674817 A DE 3726726 A	02-09-1996 13-12-1995 01-12-1988 30-03-1992 27-02-1991 27-02-1988 31-07-1990 25-02-1988

**VERSLAG VAN HET NIEUWHEIDSONDERZOEK VAN
INTERNATIONAAL TYPE**

Nummer van het verzoek om een nieuwheidsonderzoek

NL 1024819

A. CLASSIFICATIE VAN HET ONDERWERP
IPC 7 H05K13/00

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimum documentatie (classificatie gevolgd door classificatiesymbolen)
IPC 7 H05K

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EPO-Internal, WPI Data, PAJ

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie *	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
A	WO 00/05937 A (ALTMAN ISRAEL ; TEICHMAN EYAL (IL); DACHIM URI (IL); HADASI TAL (IL);) 3 februari 2000 (2000-02-03) bladzijde 13, laatste alinea - bladzijde 14, alinea 2; figuren -----	1
A	US 5 823 316 A (JONES RICHARD W ET AL) 20 oktober 1998 (1998-10-20) het gehele document -----	1
A	EP 1 251 725 A (MATSUSHITA ELECTRIC IND CO LTD) 23 oktober 2002 (2002-10-23) het gehele document -----	1



Verdere documenten worden vermeld in het vervolg van vak C.



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Datum waarop het nieuwheidsonderzoek van internationaal type werd voltooid

10 September 2004

Verzenddatum van het rapport van het nieuwheidsonderzoek van internationaal type

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De bevoegde ambtenaar

Rieutort, A

**VERSLAG VAN HET NIEUWHEIDSONDERZOEK VAN
INTERNATIONAAL TYPE**

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een nieuwheidsonderzoek
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In het rapport genoemd octroolgeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
WO 0005937	A	03-02-2000	AU 4644699 A 14-02-2000 WO 0005937 A1 03-02-2000
US 5823316	A	20-10-1998	GEEN
EP 1251725	A	23-10-2002	JP 2001230589 A 24-08-2001 EP 1251725 A1 23-10-2002 CN 1408198 T 02-04-2003 WO 0143522 A1 14-06-2001 US 2003116934 A1 26-06-2003